Biology Module 1

# Biology Module 1

## Diversity of Algae and Plants

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# TABLE OF CONTENTS

I. Biology 1, Diversity of Algae and Plants 3

II. Prerequisite Course or Knowledge 3

III. Time 3

IV. Materials 4

V. Module Rationale 4

VI. Overview 5

  6.1 Outline 6
  6.2 Graphic Organizer 8

VII. General Objective(s) 9
VIII. Specific Learning Objectives 10

IX. Pre-Assessment One 12

  9.1 Outline 12
  9.2 Answer Key 16
  9.3 Pedagogical Comment For The Learners 17

X. Key Concepts (Glossary) 18

XI. Compulsory Readings 19

XII. Compulsory Ressources 21

XIII. Useful Links 22

XIV. Teaching And Learning Activities 26

XV. Synthesis Of The Module 46

XVI. Summative Evaluation 48

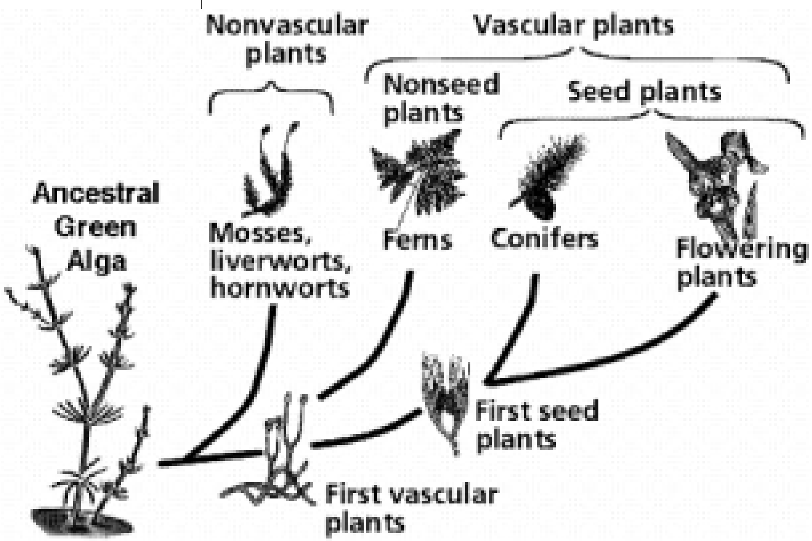
XVII. References 54

XVIII. Student Records 56

XIX. Main Author of The Module 56

# I. Biology 1, Diversity of Algae and Plants

By Dr. Memory Tekere, Biological Sciences Dept, University of Zimbabwe



Phylogenetic reconstruction of the possible relationships between plant groups and their green algal ancestors. http://www.emc.maricopa.edu/faculty/farabee/BIOBK/biobookDiversity Website accessed 26/8/06

# II. Prerequisite Course or Knowledge

High school / secondary school exit qualification acceptable for entry into University for Biology Science Education as required by your university. Special exemption can be extended to in-service biology teachers and those with relevant experience in biological sciences as determined by your university. This implies that you should have a basic understanding of plant structure and function as it relates to the work to be done in this module.

# III. Time

120 hours will be required to complete the module

# IV. Materials

Course materials include study materials (print,CD, videos,online text)

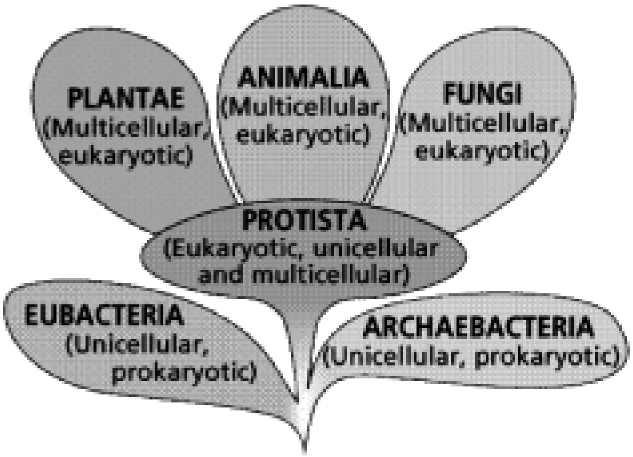
For the successful completion of this module, you will need

- access to a computer and internet,
- CD-ROMS, interactive discussions and group sessions
- recommended text books and reference materials.
- it will also be to your benefit should you have access to a well equiped central laboratory for the pratical work.
- Field trips for field work on observing plant diversity, the ecology, collection, and preservation of plants.

Preparing to mount a plant. http://en.wikipedia.org/wiki/herbarium Accessed 11/08/06

# V. Module Rationale

The module is meant to educate you (pre-service and in-service) as secondary school biology teacher with specific reference to the diversity of algae and plants. The content of the module is designed to provide you with a sound background on the teaching and learning of the algae and plant diversity through the use of ICT. Understanding the diversity of plants and algae will help you appreciate the diversity of life forms, phylogenetic relationships, ecology and economic importance. The module also forms the basis of the other biology modules such as plant physiology, cell biology, genetics and ecology. You will also be introduced to aspects of laboratory and fieldwork. These are enriching activities supplemental to the work done in this module.


PLANTAE (Multicellular, eukaryotic)
ANIMALIA (Multicellular, eukaryotic)
FUNGI (Multicellular, eukaryotic)
PROTISTA (Eukaryotic, unicellular and multicellular)
EUBACTERIA (Unicellular, prokaryotic)
ARCHAEBACTERIA (Unicellular, prokaryotic)

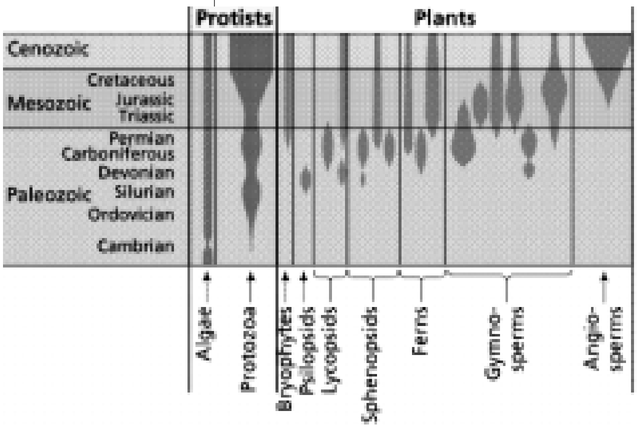
The "six" kingdom taxonomic scheme. This figure shows the position of Plants and Algae (Protist) in the diversity of life. Source : online biology book,

http://www.emc.maricopa.edu/faculty/farabee/biobk/biobookDiversity_3.html

Accessed 26/8/2006

# VI. Overview

In this module you will cover the diversity of algae (green, red and brown algae), lower plants (Bryophytes and Pteridophytes), and higher plants (Angiosperms and Gymnosperms), emphasizing their major divisions, distribution, life cycle, structures and economic importance such as food, medicinal and ecological values. The module demonstrates the biological diversity and phylogenetic relationships among/within algae and plants and finally attempts to familiarize you with information search tools, management and collaboration tools, collaborative work, and FOAD platforms.



http://www.emc.maricopa.edu/faculty/farabee/BIOBK/biobookDiversity. Accessed on the 26/8/2006

## 6.1 Outline

### Diversity Of Algae And Plants (Module 1)

**Table 1: Unit 1 – *Algae***

| | Topic | Study Hours | Practical |
|---|---|---|---|
| 1.1 | General characteristics of algae (life cycle, distribution, structure) | 5 | Self study<br>Virtual activity<br>Central lab work |
| 1.2 | Classification of algae *(Cyanophyta,Pyrrophyta Phaeophyta, Cholorophyta, Rhodophyta,Bacilariophyta, Euglenophyta)* | 13 | Self study<br>Virtual activity<br>Central lab work |
| 1.3 | Economic Importance of algae (food, medicine, ecological balance) | 4 | |
| **Total** | | **22 hours** | |

S- self , virtual and central practicals

**Table 2: Unit 2 – Lower Plants**

| | | Topic | Study Hours | Practical |
|---|---|---|---|---|
| 2.1 | | Bryophytes general characteristics (distribution, structure, life cycle) | 6 | Self study<br>Virtual activity<br>Central lab work |
| | 2.1.1 | Classification of Bryophytes | 6 | Self study<br>Virtual activity<br>Central lab work |
| | 2.1.2 | Economic importance of Bryophytes | 2 | |
| 2.2. | | Pteridophytes | | |
| | 2.2.1 | General Characteristics (distribution, structure, life cycle) | 5 | Self study<br>Virtual activity<br>Central lab work |
| | 2.2.2 | Classification | 6 | Self study<br>Virtual activity<br>Central lab work |
| | 2.2.3 | Economic Importance | 2 | |
| **Total** | | | **27 hours** | |

S- self , virtual and central practicals

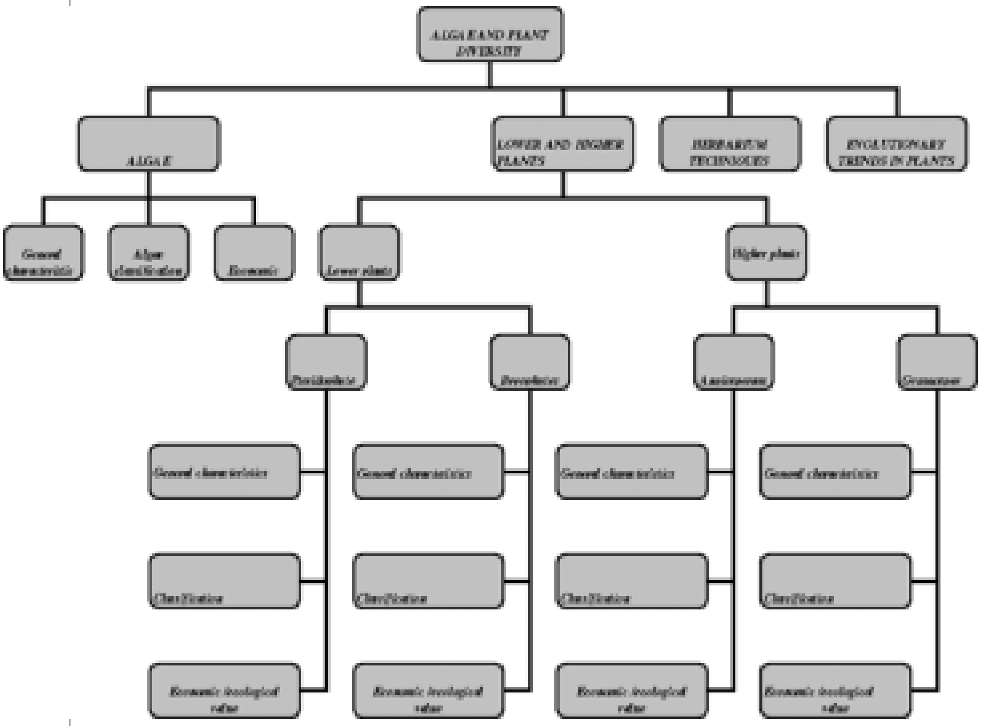
**Table 3 : Unit 3 – Higher/Seed Plants (Gymnosperms and Angiosperms)**

| | | Topic | Study Hours | Practical |
|---|---|---|---|---|
| 3.1 | | Gymnospems/Pinophyta | 14 | |
| | 3.1.1 | General characteristics (distribution, structure, life cycles) | | Self study<br>Virtual activity<br>Central lab work |
| | 3.1.2 | Classification | 8 | Self study<br>Virtual activity<br>Central lab work |
| | 3.1.3 | Economic importance | 3 | |
| 3.2 | | Angiosperms | | |
| | 3.2.1 | General characteristics (distribution, structure, life cycles) | 14 | Self study<br>Virtual activity<br>Central lab work |
| | 3.2.2 | Classification | 9 | Self study<br>Virtual activity<br>Central lab work |
| | 3.2.3 | Economic importance | 4 | |
| 3.3 | | Herbarium techniques | 14 | Self study<br>Virtual activity<br>Central lab work |
| 3.4 | | Evolutionary trends | 5 | Self study<br>Virtual activity<br>Central lab work |
| **Total** | | | **71 hours** | |

S- self , virtual and central practicals

NB – please note that though the exercise on herbarium techniques has been placed under unit 3, aspects of herbarium techniques are also covered in the other units as applicable.

## 6.2 Graphic Organizer



# VII. General Objective(s)

At the end of this module you are expected to be able to:

Describe the diversity, ecology and phylogenetic relationship of different algae and plant taxa.

Describe and compare the modes of reproduction and life cycles of various algae and plant groups.

State, describe and explain the economic importance of different algae and plant taxa.

Learn the different teaching and learning strategies associated with biology and be able to apply these when teaching the diversity of algae and plants through the use of ICT.

# VIII. Specific Learning Objectives (Instructional Objectives)

A growth of the green seaweed, *Enteromorpha* on rock substratum at the ocean shore.URL : http:www.wikipedia.org/wiki/Algae Accessed 26/8/06

## Unit 1: Diversity of Algae:

At the end of this unit, you should be able to:

1. Describe the general characteristics of algae in terms of life cycle, distribution and structure.
2. Classify algae into the different groups; red, green and brown algae showing the differences and similarities between the different members.
3. State, describe and explain the economic importance of different algae (food, medicine, ecological balance).
4. Describe the differernt techniques involved in the collection, identification and preservation of algae and be able to carry out these techniques in the field and laboratory.
5. Learn the different teaching and learning strategies associated with biology and be able to use these when teaching the diversity of algae through the use of ICT.

## Unit 2: Lower plants

### 2.1 Bryophytes

At the end of this part of the unit, you should be able to:

1. Describe the general characteristics of Bryophytes in terms of distribution, structure and life cycle.
2. Compare and contrast the properties of Bryophytes from other plants.
3. Classify Bryophytes into the different divisions; Anthocerophyta, Hepatophyta and Bryophyta and explain the difference and similarities between the different divisions.

4. List, describe and explain the economic importance of Bryophytes.
5. Describe the different techniques involved in the collection, identification and preservation of Bryophytes and be able to carry out these techniques in the field and laboratory.
6. Learn the different teaching and learning strategies associated with biology

Fern frond http://en.wikipedia.org/wiki/plant site accessed on 6/9/06

### 2.2 Pteridophytes

At the end of this part of the unit, you should be able to:

1. Describe the distribution and other general characteristics of Pteridophytes.
2. Compare and contrast the properties of Pteridophytes from other plants.
3. Describe the classification of Pteridophytes.
4. State, describe and explain the economic importance of Pteridophytes.
5. Describe the different techniques involved in the collection, identification and preservation of Pteridophytes and be able to carry out these techniques in the laboratory and field.
6. Learn the different teaching and learning strategies associated with biology and use these when teaching the diversity of Pteridophytes through ICT.

### Unit 3 : Higher/Seed Plants (Gymnosperms and Angiosperms):

At the end of this unit , you should be able to:

1. Describe the general characteristics of Gymnosperms and Angiosperms in terms of distribution, structure and life cycle.
2. Compare and contrast the properties of Gymnosperms and Angiosperms from lower plants.
3. Classify Gymnosperms and Angiosperms into their different classes.
4. Explain the difference and similarities between the Gymnosperms and Angiosperms.
5. Describe and explain the economic importance of higher plants.
6. Describe the evolutionary trends in the plant kingdom.
7. Describe the different herbarium techniques and be able to carry out the different herbarium techniques in the field and the laboratory.
8. Learn the different teaching and learning strategies associated with biology and be able to use these when teaching the diversity of Gymnosperms and Angiosperms through the use of ICT.

# IX. Pre-Assessment One

## 9.1 Rationale (Module 1)

Effective learning depends on what you already know about the subject before you attempt to master the new learning material. This pre- assessment test is intended to assess your level of knowledge on the diversity of algae and plants. It is also going to prepare you mentally for the course, allow you to demonstrate and also where possible, get credit for the concepts and skills previously mastered. Finally it will also assist the teacher to save on instruction time when the teacher do not re-teach what you already know.

**Questions**

1. Algae are classified into the kingdom
   a. Bryophyta.
   b. Monera.
   c. Protista.
   d. Chlorophyta.
2. How do green algae differ from brown algae?
   a. They contain chlorophyll a and b.
   b. They are none photosynthetic.
   c. Green algae have leaves.
   d. Green algae have roots.
3. In what way do plants differ from animals?
   a. They grow and reproduce sexually.
   b. They have chloroplast, chlorophyll and photosynthesise.
   c. Plants do not store starch as a food reserve.
   d. They cannot move and grow.
4. Which one of the following is not a Bryophyte?
   a. Moss.
   b. Liverwort.
   c. Hornwort.
   d. Euglena.

5. Which one of the following is a Pteridophyte

    a. Liverwort.
    b. Fern.
    c. Hornwort.
    d. Chlamydomonas.

6. What type of cells do advanced plants have?

    a. Prokaryotic.
    b. Leukocytic.
    c. Eukaryotic.
    d. None of the above.

7. Which ones of the following are not vascular plants?

    a. Angiosperms.
    b. Ferns.
    c. Mosses.
    d. Gymnosperms.

8. What is the name of the cell organelle where photosynthesis occur in higher plants?

    a. Chromosome.
    b. Chlorophyll.
    c. Chloroplast.
    d. Chromoplast

9. Angiosperms can be best described as …

    a. cotyledons.
    b. flowering plants.
    c. conifers.
    d. pteridophytes.

10. Which one of the following properties is true of Monocotyledonous and Dicotyledonous plants?

    a. They are flowering plants.
    b. They are seedless plants.
    c. They are gymnosperms.
    d. All of the above.

11. Which one of the following is not classified correctly?

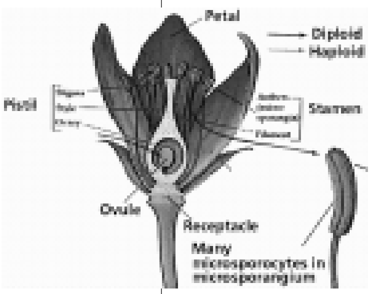
    a. Fern : Pteridophyte
    b. Conifer: Coniferophyta
    c. Hornwort: Bryophytae
    d. Brown algae: Chlorophyte

12. Which one is a FALSE statement?
    a. Bean (*Beta valguris*) is a dicotyledonous plant.
    b. Maize (*Zea mays*) is a dicotyledous plant.
    c. Maize (*Zea mays*) is a monocotyledonous plant.
    d. Bean (*Beta valguris*) is not a monocotyledonous plant.
13. What is the significance of plants having seeds?
    a. Allows for plant dispersal.
    b. Provide fruits.
    c. Provides nutrient to the grown plant.
    d. None of the above.
14. Which one of the following is not a part of a flower?
    a. Petal.
    b. Stigma.
    c. Anther.
    d. Fruit.
15. What is a herbarium?
    a. Garden of plants.
    b. Forest with different plants.
    c. Green house.
    d. Collection of preserved plants.
16. Which one of the following is NOT an economic use of plants?
    a. Some plants are used in the pulp and paper industry.
    b. Plants are sources of food for animals.
    c. Some plants are used as herbs.
    d. Plants cause soil erosion.
17. Which one of the following is a reproductive structure for gymnosperms?
    a. Flower.
    b. Seed.
    c. Anthers.
    d. None of the above.
18. Which one of the following is NOT part of plant evolution?

    The development …

    a. of a vascular system.
    b. of a seed system.
    c. from nonwoody to woody.
    d. of food preferences by animals.

19. Below is a structure of flower. Look at it critically and answer the question.



http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html

Accessed 24/8/06

What is the male reproductive structure of flowering plants called?

a. Seed.
b. Spore.
c. Stamen.
d. Stipe.

20. Which of the following is NOT part of vascular plants?

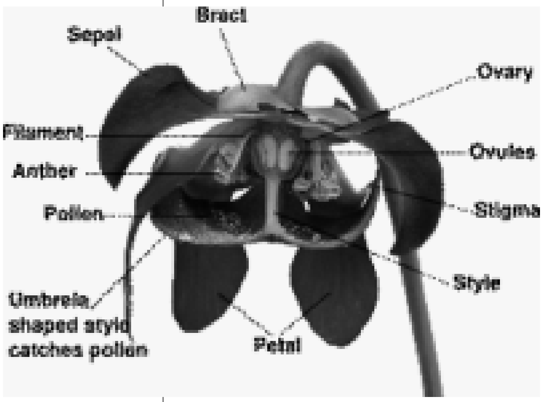
a. Roots.
b. Stem.
c. Zoospores.
d. Leaves.

## 9.2 Answer Key

1. a. Algae are classified as Protists but are studied alongside plants because they contain chlorophylls and are believed to be ancestors to plants
2. a. They contain chlorophyll *a* and *b* just like plants.
3. b. They have chloroplast, chlorophyll and photosynthesise an attribute absent in animals.
4. d. Euglena is an algae not a Bryophytae.
5. b. Ferns are Pteridopytes.
6. c. Eukaryotic – all plants have eukaryotic cells with photosynthetic pigments.
7. c. Mosses are lower plants – Bryophytes.
8. c. Chloroplast - photosynthesis occurs in chloroplasts which contain photosynthetic pigments, the chlorophylls.
9. b. Flowering plants are Angiosperms.
10. a. Monocotyledonous and dicotyledonous are flowering plants, Angiosperms.
11. d. Brown algae: is not in the algae subdivision Chlorophyte.
12. b. Maize (*Zea mays*) is not a dicotyledous plant but a monocotyledonous plant.
13. a. Seeds allow for plant dispersal, they can be carried away by dispersal agents such as water, winds and animals and germinate somewhere else.
14. d. Fruit is not part of a flower but a mature ovary which contain seeds.
15. d. A hebarium is a collection of preserved plants.
16. d. Plants do not cause soil erosion and all the other choices are values of plants.
17. b. The seed is a fertilised ovary in Gymnosperms.
18. d. Food preferences by animals is not an evolutionary trend in plants.
19. c. Stamen is the male reproductive strucure in flowering plants.
20. c. Zoospores are not parts of vascular plants.

## 9.3 Pedagogical Comment For The Learners

One could expect to achieve an average mark of 60% and beyond for this simple test. Should your performance be below this mark, then you will have to do a lot of preliminary reading to familiarise yourself with the contents of the module. Since effective learning depends on what you already know about the subject before attempting to master the new subject content, it is highly recommended that you do some preliminary reading around the subject before and after the pre-testing as to improve on your perfomance in this module.



Sarracenia Flower

http://en.wikipedia.org/wiki/Flower. Accessed on the 24/01/07

# X. Key Concepts (Glossary)

**ALGAE**
Organisms that belong to the kingdom Protista, they can be defined as photosynthetic and non photosynthetic plants with no roots, leaves and vascular tissues thus they are mostly studied along with plants. Algae are neither plants nor bacteria.

**BRYOPHYTES**
A group of non-vascular plant. The main groups of Bryophytes are: Hepaticophyta (liverworts), Anthocerotophyta (hornworts), and Bryophyta (mosses).

**THALLUS**
An undifferentiated multicellular plant body like structure, which is used to refer to the body structure of Algae and Bryophytes.

**PTERIDOPHYTES**
Group of seedless lower vascular plants. Included in this division are the ferns and fern allies.

**CHLOROPHYLL**
Light capturing - green colored photosynthetic pigment in plants. Different chlorophylls exist, namely chlorophyll a, b, and c.

**ANGIOSPERMS**
Are a group of plants that produce seeds in ovaries that mature into fruits. These are flower producing plants.

**GYMNOSPERM**
Non flowering seed producing plant, the seed are not enclosed in a fruit as is the case with angiosperms.

**DICOTYLEDONS**
Term used to refer to flowering plants with two embryonic leaves (cotyledons). True dicots are now popularly referred to as Eudicots.

**MONOCOTYLEDONS**
Flowering plants with one embryonic leaf (cotyledon).

**ALTERNATION OF GENERATIONS**
This refers to the occurrence of alternation between a diploid generation (sporophyte) and a haploid generation (gametophyte).

# XI. Compulsory Readings

**A picture of a Lily**

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html.

Accessed on 24/6/06

## Reading 1: Algae

**Complete reference :** Algae - Wikipedia, the free encyclopedia
From Wikibooks, the open-content textbooks collection
URL : http:www.wikipedia.org/wiki/Algae
Accessed on the 26th August 2006

**Abstract :** This article covers the classification and organisation of algae as plant-like Protists. Algae are a group of simple plant-like organisms with a photosynthetic ability. Algae have been traditionally treated as simple plants and are closely related to plants but they are now classified in the kingdom Protista.

**Rationale :** Reading through the article you will appreciate and understand the classification of algae, and some examples of each algal division. The article covers the relationships among algae, forms and uses of algae and algal collection and preservation. Economic and ecological values of algae such as uses in pollution control and biofuel control are also clearly covered in this article.

## Reading #2

**Complete reference** : An online Biology Book
*Biological diversity :* Protists: stem eukaryotes (revised 6/18/01)
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_3.html
*Biological diversity* : Seed plants (revised 6/18/01)
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_5.html
*Biological diversity* : Nonvascular plants and non seed vascular plants (revised 6/18/01)
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_6.html
*Biological diversity* : Flowering plants (revised 6/18/01)
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers_html
Sites visited on the 24th of August 2006

**Abstract :** This online Biology text book on Biological diversity covers in detail and in the different chapters, aspects of algae, lower and higher plant diversity. The links cover the evolutionary trends in plants and classification of the different groups.

**Rationale :** In this book and in the different chapters it is clearly shown that plants are divided into two groups namely those lacking lignin-impregnated conducting cells (the nonvascular plants) and those containing lignin-impregnated conducting cells (the vascular plants). Living groups of nonvascular plants include the bryophytes; liverworts, hornworts, and mosses. Vascular plants are the more common plants like pines, ferns, corn, and oaks. The evolutionary trends and classification are well covered with illustrations in this article.

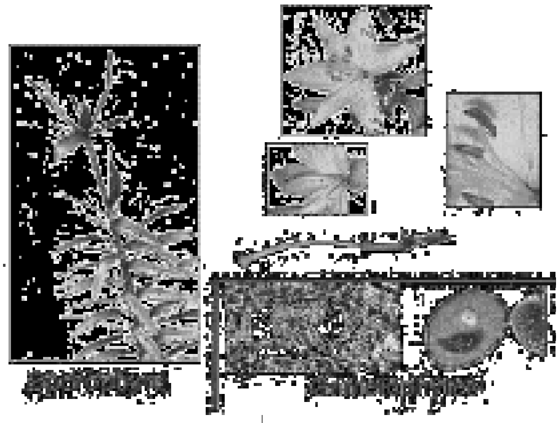
## Reading Resource #3: Pteridophytes

**Complete reference :** Fern - Wikipedia, the free encyclopedia
From Wikibooks, the open-content textbooks collection
URL : http:www.wikipedia.org/wiki/Pteridophyte
Accessed on the 26th August 2006

**Abstract :** Pteridophytes as a group of plants, are vascular and seedless. In the article it is shown that true ferns may be subdivided into the groups: Ophioglossopsida, Equisetopsida, Marattiopsida, Osmundopsida, and Gleicheniopsida. The uses of ferns are well covered in this text.

**Rationale :** The article covers details on fern (Pteridophytes) structure, evolution, classification and economics uses. Going through this article, you will clearly learn the structure and life cycles of ferns and how ferns are distinguished from vascular plants and how they are classified into their different classes.

# XII. Compulsory Resources



**Angiosperm Life Cylce**

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html Accessed on 24/08/06

### Resource # 1: Course overview video by Dr M. Tekere

**Abstract :** The video presents an overview of the module Diversity of algae and plants. In phylogeny, algae are closely related to plants and thus the diversity of algae and plants is always studied together. Characteristics and classification of algae and plants clearly show their diversity and help you to appreciate the position of algae and plants in the 5 kingdom classification scheme.

**Rationale :** The video is intended to give you a clear outline of the aspects that are covered in the module: diversity of algae and plants. Visual presentation of the overview of the module content helps you to clearly conceptualise the contents of the module.

### Resource #2: "Protists" Power point lecture presentation on Protista by Dr Will Satterwaite, Instructor in Biology: Botany and Ecological Principles

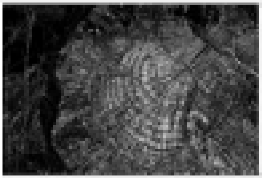
http://www.carbrillo.edu/~wsatterthwaite Site visited 26 August 2006

**Abstract:** The power point lecture covers the following aspects on Protists:
1) Basic traits of the protists
2) Evolutionary origin and diversification of the eukaryotes via endosymbiosis
3) Modern diversity of Protists, Brown Algae, Red Algae.
You will notice that Protists other than algae are also described in this module you will therefore need to concentrate on aspects of algal Protists.

**Rationale:** This power point lecture is very interesting in that it clearly gives you an overview of the Protists and diversity of Brown and Red algae while at the same time exposing you to teaching using power point.

# XIII. Useful Links

Moss on a rock



Moss growing in the shelter of the growth rings of a stump

The mossed tree

**Moss in different habitats.**
http://en.wikipedia.org/wiki/Moss
Accessed on the 26th of August 2006.

## Useful Link #1 Diversity of Lower Plants

**Title :** Protista, Algae, Bryophyte,Pteridophyte
From Wikibooks, the open-content textbooks collection
URL : http:www.wikipedia.org
http://en.wikipedia.org/wiki/Bryophyte
http://en.wikipedia.org/wiki/Protista
http://en.wikipedia.org/wiki/Pteridophyte
http://en.wikipedia.org/wiki/Algae

**Description:** The chapter links under URL : http:www.wikipedia.org, give you an overview of the Pteridophytes, Bryophytes and Algae/Protists covering the aspects of classification, structure and uses. Algae are classified as Protists, and Bryophytes and Pteridophytes as nonseed plants.

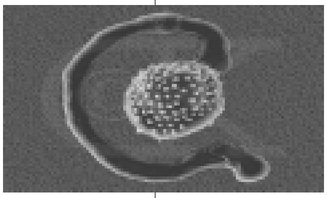
**Rationale:** In the study of Biological diversity, it is important to learn the diversity of the lower plants Pteridophytes and Bryophytes and Algae/Protista and to understand their evolutionary trends in relationship to higher plants; the Angiosperms and Gymnosperms. Algae, Bryophytes and Pteridophytes have many ecological and economic values and these are well covered in these links.

## Useful Link #2

**Title :** An Online Biology Book
URL : http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookTOC...
On-Line Biology Book: Table of Contents

**Description :** The link covers the diversity of algae and plants under the following chapters:
47 Biological diversity – Protists
49 Biological diversity – nonvascular plants and non seed vascular plants
50 Biological diversity – Seed plants

**Rationale :** Reading through the text you will appreciate the evolution and evolutionary trends in algae and plants and the reasons for studying algae and plants together. In this book the characteristics, identification and distribution of algae and plants are well illustrated with specific examples.



**Germinating Pollen Grain from a Lily**
Sauromatum guttatum (SEM x3,300)
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html Accessed 24/08/06

## Resource # 3: Algae

**Complete reference :** Algae - Wikipedia, the free encyclopedia
From Wikibooks, the open-content textbooks collection
URL : http:www.wikipedia.org/wiki/Algae
Accessed on the 26th August 2006

**Abstract :** The article covers the classification and organisation of algae as plant-like Protists. Algae are a group of simple plant-like organism, with a photosynthetic ability. Algae have been traditional treated as simple plants and are closely related to plants but they are now classified in the kingdom Protista.

**Rationale :**Reading through the article you will appreciate and understand the classification of algae, and some examples of each algal division. The article covers the relationships among algae, forms and uses of algae and algal collection and preservation. Economic and ecological values of algae such as uses in pollution control and biofuel control are also covered in this article.

## Useful Link #4

**Title :** Collecting Herbarium Specimens
URL:http:www. http://artemis.austincollege.edu/acad/bio/gdiggs/collecting.htm
Visited 28/8/06

**Description :** A herbarium is a collection of pressed, dried and preserved plant specimens. Herbaria are among the most important tools in studying the plants of a given area. Herbaria are invaluable *reference collections* used as means of identifying specimens of unknown plants. Herbarium specimens, provide a valuable *historical record* of where plants occurred in the past in both space and time.

**Rationale :** The link clearly defines and covers the uses of a hebarium. The techniques involved in the collection and pressing of specimens, and cataloguing of the plants are well covered in this link.

## Useful Link #5

**Title :** Teaching tools and resources (biology)
http://spot.colorado.edu/~dubin/bookmarks/b/1300.html
Screen Capture: TEACHING TOOLS AND RESOURCES (BIOLOGY)
Return to the NeuraLinksPlus Index Page
To report a broken link or to suggest a new link send me e-mail see also:
Pedagogy: Resources category on the NeuroLinksPlus
*Index Page*
*Access Excellence (Genentech)*
*Biology Curriculum*
Curriculum plans for High School in New Zealand
*Biology Labs Online*
Intro college and AP H.S. level online labs. Requires subscription fee.
*Biology Place*

**Description** : The link gives over 14 000 links by type and resources category on Pedagogy in Biology. These include e-modules for students, online sites for introductory biology textbooks and Online Biology Labs.

**Rationale :** The site is very relevant since ther are a number of links covering plant Biology and Botany. There are animations, projects and tutorials that can be adopted for learning and teaching various aspects of this module.

## Useful Link # 6

**Title:** Teaching Resources for Biology
http://www.csun.edu/science/biology/index.html

**Description :** The site offers many learning resources for teaching science as it is shown in this screen capture.

**Rationale :** A number of strategies, activities and resources for teaching plant sciences are offered through the various links on this website. These include database of flowers, virtual herbariums, glossary for Botany and these can be incorporated into the learning and teaching of Plant diversity.

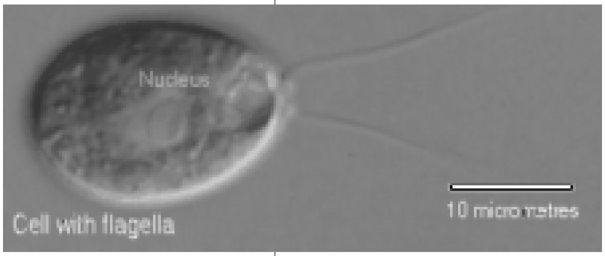
Sourcebook
THE SOURCEBOOK FOR TEACHING SCIENCE
Strategies, Activities, and Internet Resources
Norman Herr, Ph.D.
Physics
Chemistry
Biology
Geoscience
General Resources
Subject-Specific Resources
Resources for teaching Biology

- Anatomy & Physiology
- Biochemistry
- Botany and Plant Biology
- Cytology & Histology
- Ecology & Environmental Science
- Genetics
- Microbiology
- Microscopy
- Senses
- Zoology and Marine Biology
- Curriculum Standards
- Health Education
- Advanced Placement Biology
- Laboratory Safety
- Science Supply Companies
- Science Museums
- Science Shows
- Lesson Plan Ideas
- Professional Groups
- Reference Data

# XIV. Teaching And Learning Activities

**Activity 1**

## Title: Characteristics, classification and economic importance of algae



Chlamydomonas, a uni-celled, bi-flagellated green alga. http://www.emc.maricopa.edu/faculty/farabee/biobk/biobookDiversity_3.html
Site visited on 24/8/06

### Summary of the learning activity :

In this learning activity, you will learn the different criteria that are used in algal classification and identification such as algal color/ pigments present and cell morphology. Algae are made up of an undifferentiated plant body like structure called the 'Thallus'. They are widely distributed in the environment, both terrestial and aquatic, you will therefore be able to learn about the distribution and diversity of algae in these environments and how they relate to plants. Algae have significant economic and ecological values, you will learn about these values. Learning will involve a number of activities such as reading about algae, their characteristics, classification and also their economic importance to society. Should you have access to a laboratory, it is suggested you access this facility to learn more about algae particularly microscopic work on algae morphology. This learning activity could also include field visits and concluded by observations, report writing and an assignment.

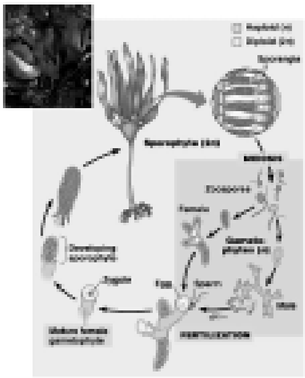
(Refer to table 1 (unit 1 content overview) for content and timelineS)

### Key Concepts

**Thallus** - an undifferentiated plant body like structure, which is used to refer to the body structure of algae.

**Pigment** - colored organic compounds, and in algae the pigments common are chlorophyll a,b,c and some carotenoids.

**Life cycle** - sequence of events in the growth and reproduction of an organism see fig below



Many of the large multicellular algae ("kelps"), including many brown, red, and green algae, exhibit this kind of life cycle, which is like the life cycle of plants.

http://www.carbrillo.edu/~wsatterthwaite Site visited on 26 August 2006

**Ecological value** – functions in the environment, both negative and positive contributions. Shows how organisms interact with their environment

**Cell morphology** – cellular appearance or organisation. For algae cell size and shape vary from unicellular, multicellular, colonial, filamentous and to a mass of protoplast.

## List of relevant readings:

Power point lecture presentation on Protista by Dr Will Satterwaite, Instructor in Biology: Botany and Ecological Principles

http://www.carbrillo.edu/~wsatterthwaite

***PDF file of the hand out provided (see file memory-ppt-.pdf)

## List of relevant useful links :

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/biobookDiversity_3.html

Chapter 47- Biological diversity – Protists – stem plants

**Relevant book reference:** van den Hoek C., Mann, D.G. and Jahns, H.M. (1995). Algae: an introduction to Phycology. Cambridge: Cambridge University press.

## Detailed description of the activity :

Algae, particularly green algae share a lot of characteristics with plants. They are pigmented, containing at least some chlorophyll and photosynthesise, however they lack specialisation of the body, no roots, leaves or stem. Higher plants are thought to have evolved from algae. Algae can be simply grouped into the 3 groups red algae (Rhodophyta), the brown algae (Phaeophyta) and green algae (Chlorophyta), however the broad classification divides algae into the divisions Euglenophyta, Bacillarophyta, Chlorophyta, Rhodophyta, Cyanophyta, Pyrrophyta, Cryptophyta, Chrysophyta, Phaeophyta and Xanthophyta. Algal classification involves the use of characteristic features such as cell wall components, pigments present (or color), life cycle and type of compounds used for food storage. Algae as a very diverse group of organisms range in size and shape, from unicellular, multicellular, colonial, filamentous and to a mass of protoplast. Algae are found just about anywhere where there is water. Algae have many beneficial uses to man. They can be used for effluent treatment, as a source of food and for biofuel production. Seaweds can be harvested and used as manure. Commercially, algae can be used in the production of agar.

## LEARNING ACTIVITIES

### 1.1 Readings : Read the references

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/biobookDiversity_3.html

Chapter 47- Biological diversity – Protists – stem plants

http://en.wikipedia.org/wiki/algae

These readings provide you with an overview on the characterisation, distribution, classification and ecolological/economic value of algae. Make notes under each of the following subheadings:

i) Characterisation of algae
ii) Classification of Algae
iii) Algae distribution
iv) Collecting and preserving algae
iv) Economic and ecological values

### 1.2. Laboratory Practical

**Title :** Diversity And Morphology Of Algae

In this exercise you will be required to examine different water samples for the diversity of algae and to learn more about their morphology.

**Practical Objective:** To study the morphology and diversity of algae

**Materials**: Microscope and slides, different water sample flasks with algal specimen (different algae species can be mixed in one flask of water), Pasteur pipette, demonstration slides (where possible).

Read the link

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/biobookDiversity_3.html

which covers some of the characteristics and identification of algae that you can observe in the field, you can refer to this reference during your lab work and on report writing.

**Procedure** : At a central lab, you will examine different water samples for Green algae (other algal specimens can also be provided) microscopically. Make wet mounts of the specimens provided and draw well labelled diagrams of your observations.

**Report** : You are required to write a report based on your laboratory observations making comments on the structure, distribution and identificaton of the algae.

### Framework For Report Writing

Your write up should have the following sections;

**Title :** As given for the practical activity

**Introduction :** Brief subject background, highlighting the subject of the practical and principles and objectives. Relevant literature should be used and quoted properly (minimum 3 references, use the APA reference system as given in the Appendix 1 of this module). The introduction should not exceed a page in length.

**Materials and Methods** : Under this section, you are to describe how you did the practical.

**Results** : Present all your results/observations clearly, whether they are qualitative or quantitative. Appropriate presentation; verbal description (past tense), tables, diagrams, calculations etc should be clearly and correctly given.

**Discussion :** Interpret your results against the goal of the experiment. Show theoretical expectations and explain any deviations. Refer to literature and cite it properly. Draw some conclusions on your findings and expectations.

**References** : All references used in the write up should be quoted here otherwise they are of no use in text and you will get no marks. A minimum of 3 references should be used and quoted here. Use the APA system of reference given to you in Appendix 1 of your module.

### 1.3. Field / Self Studies

In this exercise you are required to observe and collect different algae species from different aquatic environments

**Objective:** To study the distribution and diversity of algae in the environment

**Procedure :** Visit sites – Swimming pool, waterholes, river, oceanic sites, water pools by road sides, lakes. You are expected to go to at least 3 of the above mentioned water sites. Look and take note of the occurence of some algae. Having done your reading in activity 1.1, use this knowledge on some of the characteristics, identity, collection and preservation of algae, to guide you on your field tour, observations and collection of algae.

**Report :** You are required to write a report (5 pages) based on your observations making comments on the observable structures, distribution, diversity and identification of the algae. Comment on the collection and methods of preservation of algae.

### 1.4 Assignment

A wide diversity of algae exist in the environment and in different habitats in Africa. Giving named specific examples, describe the different types of algal habitats, diversity of the algae, habitat adaptation and the ecological values of the algae.

**Answer frame work** : Algae can be found in freshwater and marine environments, they can be in different forms, sizes etc. You are therefore expected to give the type of habitat (marine/fresh water, lakes,ponds, rivers etc), the divisions of algae present, how the algae survive or adapt to the habitat. As part of the ecological value for example algae replenish the $O^2$ in the water bodies and breakdown pollutants, these should be well covered in your answer which should be 5 typed pages long.

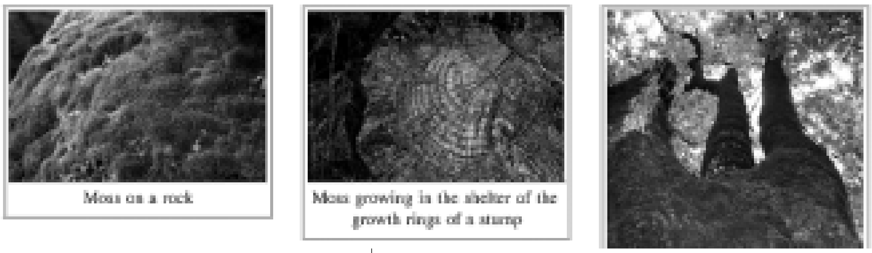
### 1.5 Formative evaluation : Conceptual problem

A small informal settlement is discharging its waste water, enriched with organic/ human waste into a nearby water dump. Describe the diversity, habitat adaption and ecological effects of algae.

**Answer frame work :** Algae "blooms" usually occur when there is a lot of organic waste in the water bodies (under eutrophic conditions), you are expected to know the types of algae that exist in polluted water, how they survive and why? Mostly an organism will thrive in an environment providing for its growth needs and usually contribute something negative or positive. Your essay should be 5 typed pages long.

# Title: Diversity of Lower Plants

## Activity 2



Moss on a rock

Moss growing in the shelter of the growth rings of a stump

The mossed tree

**Moss in different habitats.**
http://en.wikipedia.org/wiki/Moss
Accessed on the 26th of August 2006.

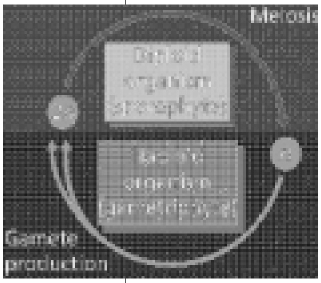
### Summary of the learning activity :

Summary of the learning activity: Lower plants are a group of plants consisting of the Pteridophytes (Ferns/ lower vascular plants) and Bryophytes (non-vascular plants). The Bryophytes consist of the divisions; Hepatophyta (liverworts), Anthocerotophyta, (hornworts) and Bryophyta (mosses). Pteridophytes on the other hand is a group made up of the divisions Psilophyta (whisk ferns), Lycophyta (club mosses and quilworts), Sphenophyta (horsetails) and Pterophyta (ferns). Bryophytes and Pteridophytes exhibit an alternation of generations in their life cycles. In Bryophytes the haploid gametophyte is the green plant we see, with the only diploid structure being the sporangium in season. Pteridophytes reproduce by spores (they do not produce seeds) and the sporopyte is the dorminant form of the life cylce. In this learning activity you will learn the different characteristics, life cycles, distribution, uses, collection and preservation of Bryophytes and Pteridophytes. Learning will involve a number of activities such as reading and making notes about Bryophytes and Pteridophytes, their characteristics, classification and also their economic importance to society. This learning activity will include a field visit and is concluded by observations, report writing and an assignment. This learning activity will cover all the content on Unit 2 (refer to Table 2 for content and timelines).

## Key Concepts

**Gametophyte** - gamete producing part of the life cycle of plants that exhibit alternation of generations and it is usually haploid (n).

**Sporophyte**- gamete producing part of the life cycle of plants that exhibit alternation of generations and it is diploid (2n)



Typical alternation of generations life cycle, such as occur in some protistans and plants. Source:- *Biological diversity : Nonvascular plants and non seed vascular plants (revised 6/18/01)*

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_6.html

Site visited on the 24th of August 2006

**Alternation of generations**- refers to the occurence of alternation between a diploid generation (sporophyte) and a haploid generation (gametophyte)

**Sporangium** - spore bearing structure

**Vascular system** - specialised system for transporting water and organic nutrients. The vascular system consists of the vascular tissues root, stem and leaves.

## List of relevant readings :

Biological diversity : Nonvascular plants and non seed vascular plants http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_6.htmlSite visited on the 24th of August 2006

Mader, S. (2004) Biology 8th edition. McGraw-Hill, Sydney, Boston

**Complete reference** : Non-seed plants

http://www.cas.vanderbilt.edu/bioimages/pages/non-seed-plants.htm

site accessed 28/8/06

## List of relevant resources : Pteridophytes

**Complete reference** : Fern - Wikipedia, the free encyclopedia
From Wikibooks, the open-content textbooks collection
URL : http:www.wikipedia.org/wiki/Pteridophyte
Accessed on the 26th August 2006

**Complete reference** : Moss - Wikipedia, the free encyclopedia

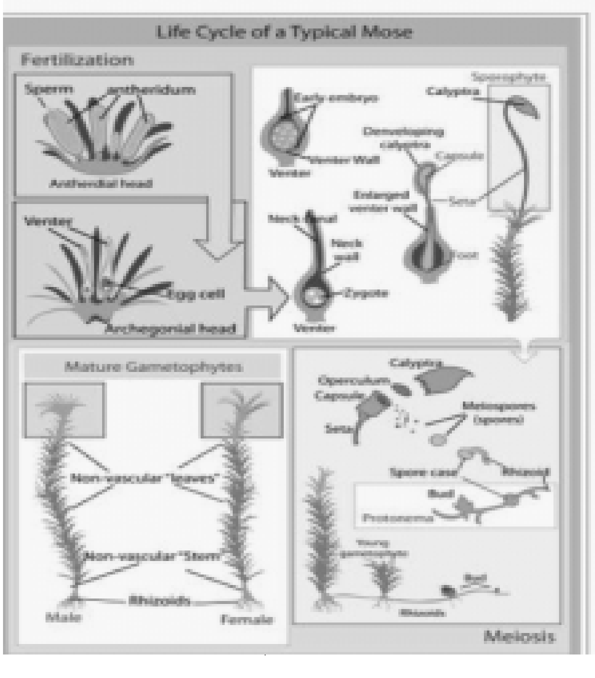
http://en.wikipedia.org/wiki/Moss
Accessed on the 28th August 2006

## List of relevant useful links : Title : Filicopsida

URL : http://tolweb.org/tree?group=Filicopsida&contgroup=Embryophytes

Site visited on the 28th of August 2006

**Detailed description of the activity:** In this activity you are going to learn about the diversity and life cycles of Bryophytes and Pteridophytes. In Bryophytes, you will notice that most of them are small, 2 -20 cm in height, and the gametophyte is the dorminant part of the life cycle. The lack of vascular system limits the size of the Bryophytes. The Bryophytes are made of root-like, stem-like and leave-like structures. The root-like structures are known as rhizoids. Most people are familiar with Bryophyte mosses which form soft green carpet like covering in moist shade environments such as damp banks, trees and rock surfaces. Living groups of the Bryophytes include liverworts (division Anthocerophyta), hornworts (division Hepatophyta), and mosses (division Bryophyta). The features that are used to in the classification of Bryophytes include the nature of the thallus and where present the leaves and the extend of development of the juvenile phase of the gametophyte. Pteridophytes, (ferns and fern allies) can be describe as the simple and early vascular plants. Fern allies include the divisions *Psilophyta*, *Lycophyta* and division *Sphenophyta*, The true ferns are in the division *Pteridophyta*, and they consist of true leafy structures and vascular tissues. As you will be studying the ferns you will notice that the leaves are the prominent parts and are usually pinnate or bi-pinnate. In this activity you will also learn about the distribution, structure and life cycles of Pteridophytes and Bryophytes and how the different groups are adapted to life on land.



**Moss life cycle**
http://en.wikipedia.org/wiki/Moss
Site accessed on 28-8-06

## Learning Activities

### Activity 2.1 Readings

Before you can master other activities on Lower plants, it is imperative that you do extensive reading on the subject. Read the following links;

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_6.html visited on the 24th of August 2006 and titled Biological diversity : Non vascular plants and non seed vascular plants.

http://en.wikipedia.org/wiki/Fern Fern - Wikipedia, the free encyclopedia Accessed on the 28th August 2006

http://en.wikipedia.org/wiki/Moss Moss - Wikipedia, the free encyclopedia Accessed on the 28th August 2006

http://www.cas.vanderbilt.edu/bioimages/pages/non-seed-plants.htm titled nonseed plants site accessed 28/8/06

These readings will provide you with an overview of the plant kingdom and evolution of plants. The characteristics (particularly life cycles), distribution, classification and ecolological/economic value of Bryophytes and Pteridophytes are well covered in this reference. After the readings write notes in a 10 paged report under each of the following subheadings on Bryophytes and Pteridophytes;

i) Evolution and classification
ii) Life cycles
iii) Distribution and
iv) Economic ecological values.

Your notes should include relevant well labelled and referenced diagrams and pictures.

### Activity 2.2 Field based activities

Make a visit to a local forest or nearest botanical garden to study the diversity make collections of Bryophytes and Pteridophytes that exist there. You need to take a notebook along with you. Using your knowledge on Pteridophytes and Bryophytes from the relevant and useful links given in this module and your reading from elsewhere, make field observations of the different types of mosses, liverworts, hornworts and ferns and make collections of the plants for a herbarium.

During this field exercise you are expected to:-

- take note of the specimens' place of occurrence (habitat)
- draw the observable structures of the collected specimens and comment on the structures of the different groups eg for the true ferns note the root-like

structure (rhizome), pinnate or bipinnate fronds (leaves), sori on the under side of leaf.

- compare and contrast the structures of liverworts, hornworts, and mosses.

At the end of the field visit write a report on your field observations and comment on the structural adaptations of Pteridophytes and Bryophytes to life on land.

Name of sites visited, description of sites and date of visit(s) should be given in your report, 10 pages long.

### 2.3 Formative evaluation

**Question:** Compare and contrast the Bryophytes from the Pteridophytes.

**Answer frame work :**
Your answer (5 pages long and typed) should cover the following aspect :

i) vascular system
ii) different classes in each group
iii) typical life cycles
iv) evolution and adaptation to life on land.

# Activity 3

# Title of Activity : Diversity of Higher Plants

Trees of a Pinophyta species :Araucaria heterophylla (Araucariaceae)
http://en.wikipedia.org/wiki/Conifers, accessed 31/08/06

## Summary of the learning activity

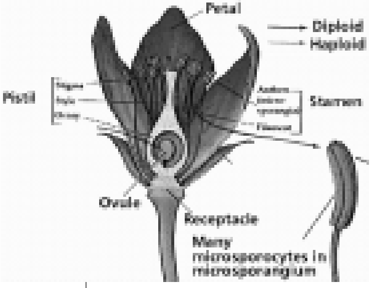
This learning activity is going to cover the aspects on evolution, classification, identification, ecology, ecological and economic uses of 'Higher Plants', the Gymonosperms and Angiosperms (refer to table 3 (unit 3) for the content and timelines). Gymnosperms are known as higher plants that produce 'naked' seed meaning that they have seeds that are not enclosed within an ovary and the following are Gymnosperm divisions:Conniferophyta, Gnetophyta, Cycadophyta and Ginkophyta. Gymnosperms are usually evergreen and are a major source of softwood. Other uses of gymnosperms are as sources of food, essential oils used in soaps, air fresheners, disinfectants, pharmaceuticals, cosmetics, and perfumes; of tannin, used for curing leather; and of turpentines (cited on http://en.wikipedia.org/wiki/Gymnosperm, accessed 31/08/06). Angiosperms are the flowering plants, they belong to the division *Anthophyta* and they are found in all types of habitats on land and water and in different sizes. Angiosperms also produce seeds but they differ from the gymnosperms in that they produce flowers and the seeds are enclosed in a fruit. The ovule (immature seed) in angiosperms is exposed at the time of pollination, the pollen grain has to penetrate the carpelary before fertilising the ovule. The different types of flowers and pollination will be covered and you will learn that the angiosperms as a group are more adapted to life on the land than other groups of plants. Examples of uses of flowering plants in our everyday life include being sources of food, medicines, and clothing material.

## Key Concepts

**Alternation of generations:** this refers to the occurrence of alternation between a diploid generation (sporophyte) and a haploid generation (gametophyte)

**Seeds** – mature ovule that contain an embryo and stored food within a protective seed coat. In Angiosperms the seed is naked, not enclosed in a fruit where as in Gymnosperms it is enclosed in the fruit. Seed production is one of the major evolutionary developments in plants. The young sporophyte in the seed is protected and have high chances of survival, it can be dispersed and it germinates to establish itself.

**Flowers** – reproductive plant structure in Angiosperms which consists of the petals, stamens, carpels and sepals as shown in figure below. The petals (pistil) consist of the female reproductivep parts (stigma, style and ovary) and the stamen is the male reproductive unit consisting of the anthers and filament. Flowers exhibit a lot of diversity eg in color and this adapts them to their mode of dispersal for effective reproduction or pollination.



http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html Accessed on 24/8/06

**Pollination :** The transfer of pollen from an anther to the stigma and this is through pollination agents such as wind and insects

**Endosperm :** The part of the seed that is used for food storage. It is enclosed in a seedcoat together with the embryo (young sporophyte plant).

## List of relevant readings

**Biological Diversity: Seed Plants**
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_6.html Site visited on the 24th of August 2006

**Flowering plant reproduction: Flower Structure**
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html Site visited on the 24th of August 2006

**Mader, S. (2004) Biology 8th edition**. McGraw-Hill, Sydney, Boston

**Pinophyta**
http://en.wikipedia.org/wiki/Conifers, accessed 31/08/06

## List of relevant resources

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowersII.html
Online-Biology-book\BioBookflowersII.html

Stern, K. R. (1985) Introductory Plant Biology . IOWA: Wm C. Brown Publishers.

## List of useful links

Pinophyta
http://en.wikipedia.org/wiki/Conifers, accessed 31/08/06

Gymnosperms http://en.wikipedia.org/wiki/Gymnosperm
Accessed 31/08/06

Flowering plants
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html
Accessed on 24/8/06

Flowering Plants
http://www.biocrawler.com/encyclopedia/Flowering_plant, accessed on 31/8/06

## Detailed description of the activity :

A survey on the diversity of Gymnosperms and Angiosperms demonstrates a great diversity and adaptation of the plants to life on land. In this activity you will learn about the life cycles and classification of Gymnosperms and Angiosperms. Gymnosperms are divided into the divisions; Pinophyta – *Conifers*, Ginkgophyta- *Ginkgo*, Cycadophyta- *Cycads* and Gnetophyta –*Gnetum*. Angiosperms and gymnosperms are both vascular seed plants but they differ in that only Angiosperms (division Pinophyta) produce flowers. Examples of flowering plant families include the Cactus, Mustard, Mint, Pumpkin, Grass, Lily, Orchid and Legume families. You will learn the different characteristics and classification of the Angiosperms and Gymnosperm and describe the differences between the two groups. Angiosperms are made of two classes namely the monocotyledous plants and the dicotyledonous plants (eudicots). You will learn the typical structure of a flowering plant, how to distinguish monocots from dicots and the major specialisation trends in flowering plants.

## Learning activities :

### 3.1. Reading

**Read the following links on Angiosperms and Gymnosperms**

Flowering plant reproduction: Flower Structure
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html
Site accessed on the 24/08/06

http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowersII.html
Online-Biology-book\BioBookflowersII.html
Accesed 24/08/06

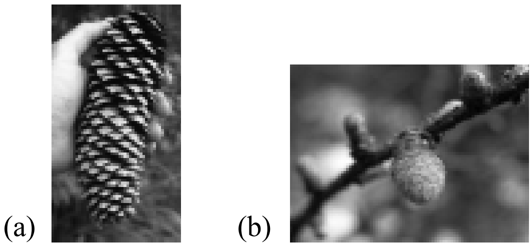
http://en.wikipedia.org/wiki/Gymnosperm
Accessed 31/08/06

http://www.biocrawler.com/encyclopedia/Flowering_plant, accessed on 31/8/06
These link readings will provide you with an overview of the evolution, and classification of Angiosperms and Gymnosperms. The characteristics (particularly life cycles), distribution, and ecolological/economic value are also covered in these references. Using these readings write notes (10 typed and doubled spaced pages) on Angiosperms and Gymnosperms under the following:

i. Evolution, diversity, classification and distribution
ii. Reproduction and life cycles (aspects of seed and flower structure should be well covered here)
iii. Ecolological and economic values

Your notes should include relevant diagrams and illustrations.

### 3.2 Diversity of Gymnosperms



(a) Pinaceae: cone of Picea abies and

(b) Pinaceae: pollen cone of Larix kaempferi
Soure http://en.wikipedia.org/wiki/Conifers
Accessed on 28/8/06

**Objectives** : To study the diversity, life cycle and reproductive structures of Gymnosperms

**Introduction :** Life forms in Gymnosperms include the palm-like trees (cycads), tall trees (ginkgos and conifers), shrubs and climbers (Gnetum). The conifer (eg pine trees) are the most common Gymnosperms nowadays (Halward and Steingraeber, 2003). The pine tree is the mature sporophyte and it bears the male and the female cones (strobillus). The cones take from four months to three years to reach maturity, and when mature the scales usually spread open allowing the seeds to fall out and be dispersed by the wind http://en.wikipedia.org/wiki/Conifers. Male cones are composed of microsporangia which produce yellowish pollen. And in pines the male cones are smaller than female cones and occur in clusters on lower branches as compared to the female cones. Female cones are composed of numerous scales and they are more complex than male cones and are borne on upper branches of the pine tree.

**Procedure**

**Diversity of Angiosperms in your locality** : Undertake a visit to observe the diversity of Gymnosperms in your local area (it could be in your neighbourhood, botanical garden or nearest forest where diversity of Gymnosperms is well represented). Use the readings (useful links provided and any other relevant material) to help you with the identification of the Gymnosperms. Make the following records: date, scientific and common name of plant, site/habitat description, observable plant morphological features such as leaf size, color and shape, and presence and type of seeds. In what ways are the observed Gymnosperms structurally similar or differrent.

**Pine tree life cycle** : Collect male and female cones of Pine trees (the assumption here is that students can access forests or neighbourhoods with pine trees however in the event that it is not easy for the student to get these, it is recommended that the student can get demonstration specimens through their ODeL centres / tutors). As much as is possible collect cones at various stages of growth. Make the following observations: morphology of cones, differences between the cones especially between female cones at different stages of growth, and seeds if present. Your observations should be accompanied by clearly labelled diagrams.

Write a report detailing the life cycle of a Pine tree.

### 3.3 Diversity of Angiosperms

**Objective :** To study the diversity of Angiosperms indegenous to your area

Procedure : It is hoped that irregardless of where you live it is possible to easily access a forest with wild/indegenous Angiosperm trees and plants. Take a trip to the forest to observe the diversity of the indegenous Angiosperms. Make the following observations and recordings:

Date, locality, growth forms, size of tree, leaf form and size, scientific and local name (where possible), presence and type of flowers and fruits, leaf arrangement and venation. Write and submit a 3 page report on the diversity of the Angiosperm species you observed. Appropriate pictures and diagrams should accompany your report.

### 3.4 Flower structure

**Objective :** To study the diversity and structure of flowers

**Procedure :** Pick at least 10 different types of flowers (it is also possible to buy, however the limit here is that you do not get to see the whole flower bearing plant).

From the flowers picked, make the following observations: appearance (simple or compound, flower parts, symmetry etc), smell, and color. Giving reasons, postulate on the mode of pollination likely to occur with regard to each flower.

Using a scarpel dissect the flowers. Draw and label the floral parts. Write a report on your observations and comment on the diversity of the flowers/floral structures. Use relevant pictures and illustrations in your answer.

### 3.5 Formative evaluation

Angiosperms are better adapted to life on land than Gymnosperms. Discuss.

**Answer framework**

Your answer should be 3500 words, and you are expected to adress the following aspects in your answer

i) Evolution of vascular seed plants
ii) Differences between Angiosperms and Gymnosperms, covering aspects of life cycles and diversity of the Angiosperms and Gymnosperms.
iii) Adaptive features for life on land

## Activity 4

## Title of Activity : Herbarium Techniques

a) b)

(a) Studying a plant specimen in a Herbarium and
(b) Preparing to mount a plant
http://en.wikipedia.org/wiki/Herbarium Accessed 11/08/06

### Summary of the learning activity :

A herbarium is a collection of pressed, dried and preserved plant specimens. It serves to permanently preserve the plant specimen and ensure its accessibility among other uses. Herbaria can be desribed as libraries of preserved and pressed plants that are arranged in pressed plants that are arranged in specific order for easy location of specific plants (Stern, K.R., 1985). In an article titled Collecting Herbarium Specimens and cited on http://artemis.austincollege.edu/acad/bio/gdiggs/collecting.htm (accessed 29/8/06) the functions of a herbaria can be summarized as; i) invaluable reference collections used as means of identifying specimens of unknown plants ii) Herbarium specimens have indefinite life if properly protected, some plants are not always available throughout the year so keeping them in an herbarium ensure their perennial availability. iii) Research tools that allow for a practical way of keeping numerous species to study and compare, since it's impossible to keep thousands of live specimens of species. A number of steps are involved in the collection and preservation of plants. Requirements for creating a herbarium include; the plant material (whole plant (wherever possible), plant parts- leaves, roots, seeds, flowers, fruits), containers/khaki pockets, newspapers, plant press, binder or storage folder, knives, hoe and digger and labels. Stages in the creation of a herbarium include; plant material collection, pressing, drying, mounting, labeling and cataloguing. NB all groups of plants can be collected and preserved into the herbarium and as highlighted earlier on, herbarium techniques are an exercise that encompasses this whole module.

## Glossary/ key concepts

**Herbarium** : A collection of preserved plant specimens. Serves to permanently preserve the plant specimen and ensure its accessibility among other uses.

Plant Press An apparatus for flattening and drying plant specimens, usually consisting of two lightweight boards or frames and a pair of straps or sash cords. Defination from link http://www.herbarium.unc.edu/chpt31.html accessed 11/09/06

**Mounting** : Attaching the dried plant specimen, to be preserved in a herbarium onto mounting paper, usually glue is commonly used to fix the plant, however strapping and pinning can be used as other means of mounting the specimen. The plant material should be placed in such a way that all the details can be easily seen.

**Plant Cataloguing :** Means of organising or ordering plants in a herbarium. The arrangement of specimens should follow a particular scientific order.

**Protected plant species :** These are plants which are protected by law and usually most are endangered species, you need to get permission to access these or on the other end, any form of collection of such plants is prohibited.

## List of relevant readings

Herbaria
http://en.wikipedia.org/wiki/Herbarium
Accessed 11/09/06

http://artemis.austincollege.edu/acad/bio/gdiggs/collecting.htm
(Accessed 29/8/06)

A Herbarium
http://www.funsci.com/fun3_en/herb/herb.htm
Accessed 11/09/2006

## List of relevant resources

For relevant resources, it is encouraged that you access any books on plants, plant diversity and classification from your local library or National/local Herbarium

## List of relevant useful links

A Herbarium
http://www.funsci.com/fun3_en/herb/herb.htm
Accessed 11/09/2006

## Detailed description of the activity :

Creating a herbarium is not tied down to people with formal training - anyone can do it using simple materials and standard techniques. In this activity you are going to learn how to collect plants and create a herbarium. This will help you become familiar with plants around you and appreciate the diversity of plants that exist in terms of morphology and identity. Plants can be collected from anywhere (woodlands, cities, grasslands and mountains). Permission to collect plants should always be sought from the responsible authorities especially when collecting from gardens and parks. The following are some of the requirements for creating a herbarium: the plant material, containers/khaki pockets, newspapers, plant press, binder or storage folder, clear plastic, knives, hoe/digger and labels. Whole plants and / or representative parts such as flowers, stems, roots, leaves, seeds, etc should be collected as required for the identification of the plants. Stages in the creation of a herbarium include; collection of the plant material, pressing, drying, mounting, labeling and cataloguing. Creating a herbarium requires some reference to 'field guides'. Field guides are essentially books or brochures with information and photos or illustrations about the plant, you will need to access these to help in the identification of the plants.

### 4.1 Activity: Project on Creating a Herbarium

**Objective :** To practice the techniques involved in the creation of a herbarium

**Procedure :** You are required to undertake an excursion to collect plants (all groups of plants : Bryophytes, Pteridophytes, Angiosperms, Gymnosperms), for preservation into a herbarium. To assist you with the details expected of you in creating a good scientific herbarium, read the article on Herbarium from the link http://www.funsci.com/fun3_en/herb/herb.htm Accessed 11/09/2006

Materials required for you to carry into the field vary depending on what you can access easily and may include: card board box folder with layers of old newspaper, plastic bags, notebook, labels, khaki pockets, thorn proof gloves and digger/ hoe. In terms of the study area it is encouraged that the area of study should have a large population of indigenous or wild plant types. Carefully collect as many plants/important parts as you can find, such as seeds, leaves, stem, root and flowers). Place the plants between papers in a plant press, and each plant has to be placed in between papers for pressing separately.

Details on how to prepare your collected plant specimens are given in the links http://www.funsci.com/fun3_en/herb/herb.htm Accessed 11/09/2006

http://en.wikipedia.org/wiki/Herbarium Accessed 11/09/06
http://artemis.austincollege.edu/acad/bio/gdiggs/collecting.htm
(Accessed 29/8/06). Use these references and any other relevant references to guide you in the preparation of your herbaria.

At the end of the project, you are expected to write a project report. Your report should have the following format:

**Title of project and Accreditation:** e.g. Herbarium Project: Plant diversity in Mukuvisi woodlands, Harare, Zimbabwe

**Project by**: student name, course and study centre/ University, year of study

**Acknowledgements** : Acknowledge all people who contributed to the success of the work, it could be in ideas, finances or permission.

**Contents page** : List of content chapters, sections, figures, pictures and tables and their corresponding pages

**Introduction** - Introduce the details on Herbarium, such as how and why a herbarium is created, plant collection, preservation, legislation pertaining to plant collection, information and data recorded in the field and given at cataloguing.

**Objectives** : State why and what the project aimed to achieve.

**Materials and Methods**

Site description – name and map
Give details on tools used
Key of details that you were collecting during the field
Give details on how the plants were preserved i.e. pressing, mounting etc

**Results** – give the details obtained on plant diversity, classification and identification, habitat and habitat characteristics, uses etc. Mounts, pictures and sketches of the plants should be given.

**Discussion**- You are expected interpret your results for example, why there was such a diversity of plants, relate to the ecology and other environmental factors. Discuss any limitations or constraints you faced and give suggestions on how this can be overcome.

**References** : All literature cited should be properly listed here.
Appendix : additional information can be added here e.g Maps, raw data, tables

## 4.2 Formative evaluation

Write an essay on the different steps and details in the creation of a herbarium.

**Answer Framework**

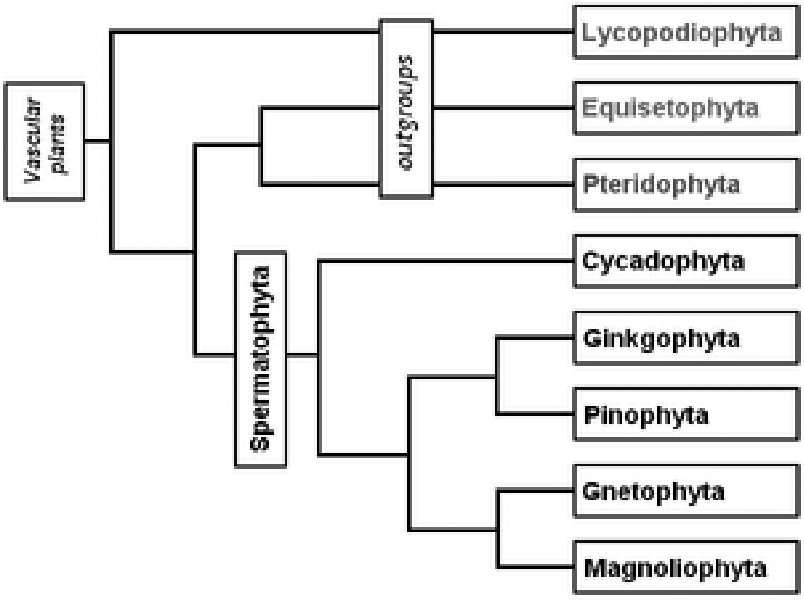
In the introduction to your answer, you are expected to define a herbarium and describe the uses and / importance of a herbarium. Aspects of how, when, what and where to collect plants should be clearly described. Describe the tools that are used/ required in plant specimen collection. Details on the information to be gathered in field, plant pressing and different pressing techniques, drying, mounting, labelling and cataloguing should be well outlined. Examples of plant identification keys should also be given.

# XV. Synthesis Of The Module

At the end of this module you are expected to know the diversity that exists in algae and plants. The content of the module is organised into 3 units and 4 main learning activities. Each learning activity is completed through a number of activities which include reading text, Laboratory and field based practicals and assignments or project(s). Unit one content is all covered under learning activity #1, while Unit 2 content is covered by activities under learning activity #2, and Unit 3 content is covered through activities under learning activity 3 and 4. Algae though they are not plants, they are studied closely to plants because plants are believed to have evolved from photosynthetic green algae. It is very important to understand the evolution of plants, from lower plants through to higher plants and particularly the major evolutionary trends towards plant adaptation to life on land. The Bryophtes are the simplest forms of plants composed of an undifferentiated plant body-like (thallus). Pteridophytes though they are also primitive and nonvascular, they posses root-, stem- and leaf-like structures and are better adapted to life on land than Bryophytes. The higher plants are composed of seed producing vascular plants belonging to the divisions Angiosperm and Gymnosperms. The Gymnosperms are nonflowering while the Angiosperms are flowering plants. You should be able to describe the classification and general characteristics of algae and each plant group and be able to distinguish between the divisions and also members of each division. You should be able to describe the life cycles of each algae and plant group and appreciate the similarities and differences in life cycles of the groups and within the divisions of each group. The transition from water dependent life cycles to life on land should be described and related well to the different life cycles. Different members of algae and plants occupy different habitats and serve different ecological functions. It is important that you should be able to describe the ecology and the ecological functions (positive/negative) of algae and plants. Appreciation of the economic importance of algae and plants is also an integral part of this module. You are therefore required to describe the economic importance of algae and plants. Mastering of the herbarium techniques is a must if you are to be able to collect, preserve and identify the algae and plants, and also describe the morphological characteristics, diversity and ecology of these life forms.

As highlighted above, the activities given in this module are mostly based on text readings, assignments, projects and practicals (field visits and lab based work) and they form the basis for your learning and understanding of the diversity of the algae and plants in theory and practice. The tasks given under the different learning activities demands that you demonstrate a high level of ICT skills competency, all the activities can be assessed and used to show how you understood the content and the learning objectives set before you. Finally you are going to write an end of module exam covering all the module content (see section 16 for details on the examination). The weighting of the continuous assessment and final exam will depend on your university regulations otherwise a situation where the exam and continuous assessment contribute 60 % and 40% of the final mark would be more commendable.

# XV. Summative Evaluation



Phylogeny of the modern Spermatophyta (seed plants) and some allied vascular plant groups. Note that the spore-bearing vascular plants are paraphyletic with respect to the seed plants, with ferns (Pteridophyta) more closely allied to seed plants than they are to clubmosses (Lycopodiophyta). http://en.wikipedia.org/wiki/Plants Accessed on 14/9/06

## End of Module Examination – Exam time : 3 Hours

The exam is based on all the aspects of algae and plant diversity you covered in this module. It will comprise of 3 sections as follows:

a) Section A - short question-short answer section and you are expected to answer all of the questions and it is worthy 25 marks
b) Section B – essay type questions, you are expected to answer 2 out of 4 questions and it is worthy 50 marks, 25 marks for each essay question attempted.
c) Section C – Practical based questions, you are expected to answer 1 out of 2 questions and it is worthy 25 marks .

The exam is best taken at a local or nearest ODeL centre. The exam will be done on the computer, saved on CD to be submitted to the examiner, an attachment of the students's answers will also be send online to the examiner. Students are required to get a pass mark of 50 % in the final exam to pass this module.

## End of Module Exam Exam time 3 Hours

You are to answer all questions in section A, 2 questions from section B and 1 question from section C. Mark allocation is as follows for the sections:- A -: 25, B-: 50 and C-: 25.

### Section A: Short answer questions (answer all questions)

1. (i) Giving a specific example, explain the term alternations of generations. (5 Marks)
   (ii) List 3 characteristics of plants. (3 Marks)
   (iii) Give 2 ways in which Pteridophytes differ from Bryophytes. (2 Marks)
   (iv) Distinguish between the following;
      a) Angiosperm and Gymnosperm (5 Marks)
      b) Monocots and Eudicots (5 Marks)
   (v) Describe 5 ecological and economic uses of algae (5 Marks)

### Section B: Essay questions ( Answer any 2 of the 4 essay questions)

2. Discuss the diversity of algae.
3. Describe the life cycle of a typical flowering plant (Angiosperm).
4. Discuss the different problems that higher plants might have encountered in transition from water to land and how these problems were overcome.
5. Write an essay on Pteridophytes

### Section C: Practical- related questions (Answer ONE question)

6. a) Draw a well labelled diagram showing the structure of a typical flower and explain why flowers are considered to be spore-bearing organs and give the evolutionary significance of a flower in plants. (15 Marks)
   b) Giving specific examples, describe the observable features that can be used to determine the type of pollination that occurs in flowering plants. (10 Marks)
7. Give an outline of the different steps involved in the setting-up of a Herbarium.

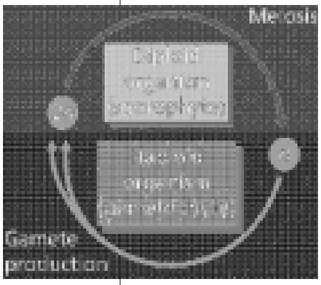
# Biology Module 1 : Diversity Of Algae And Plants

## End of Module exam Answer framework

In answering these exam questions it is always important that your answers should be accompanied with relevant illustrations (these maybe life cycle, diagrams and tables) and specific examples whereever possible.

### Section A

1. (i) Alteration of generations refers to the occurrence of alternation between a diploid generation (sporophyte) and a haploid generation (gametophyte). For example in the pine tree, the ovule in female cone divide by meiosis to form a female gametophyte that is N, then fertilisation occurs to form a zygote that is 2N which after seed germination grows into a tree (the sporophyte) that produces diploid mega- and micro- spores



Typical alternation of generations life cycle, such as occur in some protistans and plants. Source: - Biological diversity: Nonvascular plants and non seed vascular plants (revised 6/18/01)
http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookDiversity_6.html
Accessed 24/08/09

(ii). Some of the characteristics of plants are

- cells have chloroplast
- they photosynthesis
- contain cellulose containing cell walls
- life cycle exhibit alteration of generations
- can form spores

Any two will do.

(iii). The following are some of the differences between Pteridophytes and Bryophytes: Bryophytes are nonvascular, have no differentiated tissues (roots, stems, leaves), Gametophyte dominates the life cycle in Bryophytes, while it is the sporophyte in Pteridophytes.

(iv a) Angiosperms vs. Gymnosperms: angiosperms are flowering, bear fruits with seeds and bear no cones while gymnosperms are non flowering and bear no fruits or seeds that are enclosed in a fruit.

(iv. b) Monocots vs. dicotyledonous plants

Monocots – bear 1 cotyledon

- leaves are parallel veined
- have fibrous roots
- have scattered vascular bundles
- flower in multiple of 3 or in 3

Dicots – have 2 cotyledons

- leaves are net veined
- have tap root system usually
- vascular bundles are in a root
- flower in 4 or 5 or multiples of 4 and 5

(v) Uses of algae include the following;

- Serve as plankton – eaten by organisms in water or marine environments
- Replenish $O^2$ in water bodies through photosynthesis
- Diatoms are harvested for diatomaceous earth that is used as abrasive in the metal industry and for filters in clarifying beer and wines
- Produce commercially valuable cell wall polysaccharides : carrageen, algin and agar
- Used as medicine e.g. Red Kelp which is rich in iodine is dried and used for goiter treatment
- Used in pollution control – breakdown or accumulate pollutants in waste waters

The list is long so any 5 known uses can be given

**2. Diversity of algae**

- describe the common features of algae
- go on to describe the classification and properties of each division; divisions Euglenophyta, Bacillarophyta, Chlorophyta, Rhodophyta, Cyanophyta, Pyrrophyta, Cryptophyta, Chrysophyta, Phaeophyta and Xanthophyta.
- Give examples for each division and describe typical algae life cycle
- give details of algal habitats or ecology as it relates to their diversity and adaptive features

**3. Angiosperm life cycle**

- give a general description of what are angiosperms as an introduction
- describe the sporophyte and gametophyte generations and their dominancy in the life cycle

- describe the flower which is the reproductive structure
- in your answer it is a must to give an illustration of a typical flower and typical angiosperm life cycle
- give full details on the development of the microspore and megaspore
- cover aspects of pollination and fertilization (zygote formed after pollination and fertilization, develop into an embryo, ovary develop into fruit with the seeds)
- seed dispersal and then germination forming the flowering plant (sporophyte)

### 4. Problems encountered by land plants and how they were overcome.

Your answer need to include the following as they relate to problems encountered and adaptations to counter the effects:-

- need for non water dependant reproduction
- threat of desiccation due to harsh environmental conditions
- need for support system and water conduction

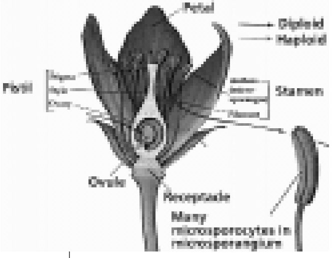
In light of the above problems land plants developed seeds for dispersal and protection of the female gametophyte. The plant (sporophyte) assumed a predominant role. There was the evolution the flower and pollen

- there was the development of specialized tissues – for conduction, support, anchorage, photosynthesis. The vascular system ensured conduction of water and nutrients, leaves can regulate water loss, features like bark help reduce desiccation
- trees could now grow tall due to the vascular support system
- plant dispersal – reduces competition for space and resources

### 5. Essay on Pteridophytes

- Pteridophytes are a group of seedless lower vascular plants. Included in this division are the ferns and fern allies.
- define Pteridophytes, highlighting their properties and classification,
- describe the groups of ferns and fern allies
- describe their typical life cycle ( draw and explain the life cycle)
- describe the ecology of the Pteridophytes
- give their ecological and economic values

### 6. A typical flower for example as below:



http://www.emc.maricopa.edu/faculty/farabee/BIOBK/BioBookflowers.html
Accessed 24/8/06

Make sure all the important parts are given and well labelled i.e. stamen showing anther and filament, receptacle, stigma, style, ovule, ovary, sepal, petals

Flowers are spore bearing in that they bear the microspores in the anther and the megaspores (female spores) in the ovule.

### 7. Creation of a herbarium

As an introduction define herbarium, materials and knowledge requirement and where plants can be collected

Steps include: - plant collection – where to collect e.g. from any natural habitat, permission should be sought if it is required for the particular area

- when to collect – best seasons, avoid rainy days or early morning when the plant is wet, avoid very hot day times, you need fresh material
- what to collect- whole plants for small plants otherwise all the representative parts i.e. roots, stems, flower, seeds, leaves etc and sufficient quantities have to be collect

Data recording in the field – Date and time of the year of collection, habitat and description e.g. mountain, forest, river

- location- country, state, landmarks
- details about the tree- height, diameter, in flower or not, flower properties any pollinators observed

Pressing of plant – describe what is pressing, how plants are pressed and what a plant press is. Give the different possible designs of plant presses e.g. the commercial type and improvised types.

Drying – describe how plants are dried emphasizing conditions and level of dryness to be achieved

Mounting – describe what is mounting, how plants should be mounted and different methods of mounting (pinning, gluing, and stripping)

Labelling and cataloguing– give all the information to be included per preserved plant ( e.g. all that would have been recorded in the field, common and scientific names, uses etc) and finally the ordering or arrangement of the specimens based on scientific information such as by evolution, family, scientific name.

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# XVIII. Student Records

Name of the EXCEL file :

Student records -Biology Module 1 : Diversity of algae and plants

# XIX. Main Author of the Module

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